REMARKS/ARGUMENTS

This Amendment is in response to the Office Action dated September 4, 2003. Claims 1-27 are pending in the present application. Claims 1, 7, 11 and 20 have been amended. Accordingly, claims 1-27 remain pending.

Amended Claims

Claims 1, 11 and 20 were amended to clarify the present invention. In particular, the claims were amended to recite "a plurality of encapsulated modules, wherein each module comprises programming code for implementing features of a storage system utilizing a Redundant Array of Inexpensive Disks (RAID) configuration." Support for the amendments is found in the Specification at page 10, lines 1-12, for example. No new matter has been presented.

Claim 7 was amended to correct an informality. No new matter has been presented and the scope of the claim remains unchanged.

Information Disclosure Statement

The Examiner did not consider the Japanese patent (JP 5257611) listed in Applicants' information disclosure statement submitted with the application because a concise explanation of its relevance was not submitted. Applicants respectfully submit that the United States counterpart (Gentry et al., US No. 5,568,629) to the Japanese patent was listed in, and submitted along with, the IDS.

Claim Objections

The Examiner objected to claim 7. Applicants respectfully submit that claim 7, as

amended, overcomes the Examiner's objections.

Claim Rejections

The Examiner rejected claims 1-8, 10-17, and 19-26 under 35 U.S.C. §102(b) as being anticipated by Tanaka et al. (U.S. Patent No. 5,542,064). The remaining claims, i.e., claims 9, 18 and 27 were rejected under 35 U.S.C. §103(a) as being unpatentable over Tanaka. In rejecting the independent claims, the Examiner stated:

> Regarding claims 1, 3, 5, 11, 13, 15, 20 and 22, Tanaka et al. teaches a data storage system with a plurality of storage devices (disk drives 16-1 to 16-n, Figure 1) in which CPU 1 is the main module of which controller 2 is a child, controller 2 is a module of which the plurality of disk processors 17-1 to 17-n are children, and the plurality of disk processors are independent modules each having a disk drive 16-1 to 16-n as a child (Figure 1). Tanaka discloses controller 2 receiving input and output command from CPU 1 and passing such commands from the controller 2 to the corresponding drive processor 17-1 to 17-n and then to the corresponding disk drive ("deciding which child to pass the input command to ... passing the input command to the decided child", Column 3, line 50 to Column 4, line 35). In this system, the source is transparent to the drive processor module in that this module does not communicate with the CPU, but instead communicated directly with a module above it, controller 2.

Applicants respectfully traverse.

The present invention is directed to a method and system for implementing non-hierarchical and hierarchical RAID configurations. According to the preferred embodiment of the present invention, non-hierarchical and hierarchical RAID configurations are viewed as a combination of RAID modules. Each particular RAID module is encapsulated, i.e., inputs and outputs are not fixed to any particular device. Thus, any hierarchical RAID configuration and any number of hierarchical tiers can be built by combining the encapsulated RAID modules. Each module represents a particular RAID level, in other words, each module contains programming code representing the features of a particular RAID level. Each encapsulated module is adapted to receive an input command, which is related to the data stored in the

physical storage devices. Unlike the conventional system, however, the module is not coded to *assume* that the source of the input is the host. Thus, in the preferred embodiment of the present invention, the source of the input command is transparent to the module.

In addition, each encapsulated module includes at least one output path, or child. The module is *not* coded to *assume* that its children are disk drives. Thus, the destination of each child is transparent to the module. Because each module is encapsulated, programming modules can be mixed and matched to form hierarchical RAID configurations with little or no programming effort. As a result, the code is simpler and easier to test and debug.

The present invention provides, as recited in claim 1:

> 1. A method for managing data in a data storage system, the data storage system including a plurality of physical storage devices, the method comprising the steps of:
>
> a) providing a plurality of encapsulated modules, wherein each module comprises programming code for implementing features of a storage system utilizing a Redundant Array of Inexpensive Disks (RAID) configuration and each module comprises at least one child;
>
> b) receiving an input command related to the data by one of the plurality of modules from a source, wherein the source is transparent to the one module;
>
> c) deciding which child of the at least one children to pass the input command; and
>
> d) passing the input command to the decided child for processing the data according to the input command.

Claims 11 and 20 are computer readable medium and system claims having similar scopes to claim 1.

In contrast to the present invention, Tanaka is directed to a method for controlling how data and back up data is written into a predetermined number of storage units, i.e., disks, in a secondary storage device. According to Tanaka, the secondary storage device 101 (Figure 2) includes a controller 2 that manages input and output commands and data from a CPU 1. The controller 2 selects disks 16-1 to 16-n having free capacity and a lower number of input/output

commands to be processed, and writes multiple copies of data to those selected disks. The controller 2 maintains a plurality of tables 12 for performing this function. The tables include an address management table 50 for managing data stored in the respective disks, a free area management table 55 for managing free areas in the respective disks and a disk drive management table 60 for managing the number of input-output commands to be processed in each of the disks.

Tanaka fails to teach or suggest "providing a plurality of encapsulated modules, wherein each module comprising programming code for implementing features of a storage system utilizing a Redundant Array of Inexpensive Disks (RAID) configuration," as recited in claims 1, 11 and 20. In the present invention, encapsulated RAID modules are used as building blocks to create hierarchical RAID configurations. By taking an objected oriented approach, hierarchical and nonhierarchical RAID configurations are easily implemented without requiring new programming code for each configuration. Because particular RAID modules are encapsulated, i.e., inputs and outputs are not fixed to any particular device, any hierarchical RAID configuration and any number of hierarchical tiers can be built by combining the encapsulated RAID modules. Minimal or no additional programming is necessary. As an added feature, background functions, such as rebuilding a degraded disk drive, can also be encapsulated in a programming module, which can then be used to simplify coding, testing and debugging.

None of the modules disclosed in Tanaka, e.g., the CPU 1, the controller 2, or the disk processors, implement "features of a storage system utilizing a . . . RAID configuration," as recited in claims 1, 11 and 20. Indeed, Tanaka expressly criticizes the RAID configuration because "there is no consideration of the input/output command waiting state of each disk drive at the time of reading/writing of data in a plurality of disk drives." (Column 2, lines 14-17).

Applicants respectfully submit that Tanaka fails to teach or suggest the cooperation of elements recited in claims 1, 11 and 20. Accordingly, claims 1, 11 and 20 are allowable. Claims 2-10, 12-19 and 21-27 depend on claims 1, 11 and 20, respectively, and the above arguments apply with equal force. Therefore, Applicants respectfully submit that claims 2-10, 12-19 and 21-27 are also allowable.

Conclusion

In view of the foregoing, it is submitted that the claims 1-27 are allowable over the cited references and are in condition for allowance. Applicants respectfully request reconsideration of the rejections and objections to the claims, as now presented.

Applicants believe that this application is in condition for allowance. Should any unresolved issues remain, Examiner is invited to call Applicants' attorney at the telephone number indicated below.

Respectfully submitted,
SAWYER LAW GROUP LLP

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Date

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